PIER Energy-Related Environmental Research
Environmental Impacts of Energy Generation, Distribution and Use

The Development of 70-Year-Old Wieslander Vegetation Type Maps and an Assessment of Landscape Change in the Central Sierra Nevada

Contract #: 500-02-004-WA, MR-035-02
Contractor: University of California, Davis
Grant Amount: $75,000
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Commission Project Manager: Gina Barkalow
Commission Contract Manager: Beth Chambers

The Issue

To maintain California's natural resources in good condition, resource managers need to know historic vegetation conditions in order to assess the level of change that has occurred. The Wieslander Vegetation Project—a decade-long effort by the U.S. Forest Service in the 1930s—mapped about one-third of the state's vegetation, providing detailed botanical data for more than 17,000 vegetation plots along with more than 3,000 landscape photos.[1]

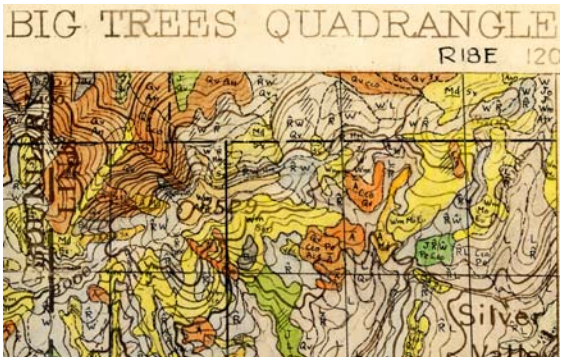

Figure 1. Example of detail in vegetation maps being digitized by this project

The Wieslander maps have recently been inventoried and identified as suitable for conversion to a geographic information system (GIS). Digital conversion will enable these valuable data sources to be used for various purposes—such as measuring the change in various habitats, calibrating dynamic vegetation models to forecast the impacts of climate change, managing forests and endangered species, and identifying potential lands for carbon sequestration.

Project Description

The project digitized a series of the vegetation maps covering a 30,236-km^2 area extending from the Central Valley to the east side of the Sierra Nevada at Yosemite National Park (Figure 2). These maps represent the best historical view of the extent of different vegetation in California.

The project team developed methods to digitize the historic maps and render them to a georectified database. The species-level descriptions from the maps were converted to a modern classification system, the California Wildlife Habitat Relationships (WHR) model.[2] Historical

[1] See http://vtm.berkeley.edu.

[2] California Department of Fish and Game. 2004. The California wildlife habitat relationships system. Sacramento, CA.. http://www.dfg.ca.gov/whdab/html/wildlife_habitats.html.

data were then compared with CalVeg, a modern vegetation map produced by the US Forest Service in 1996, which also uses the WHR classification system.[3] In addition, the extent of *Pinus ponderosa* forests on the Placerville quadrangle (El Dorado County east of Sacramento) was compared to a historical map from 1850 as well as the 1934 Wieslander map, enabling measurement of the loss of Ponderosa forest over 146 years.[4]

PIER Program Objectives and Anticipated Benefits for California

This project offers numerous benefits and meets the following PIER program objective:

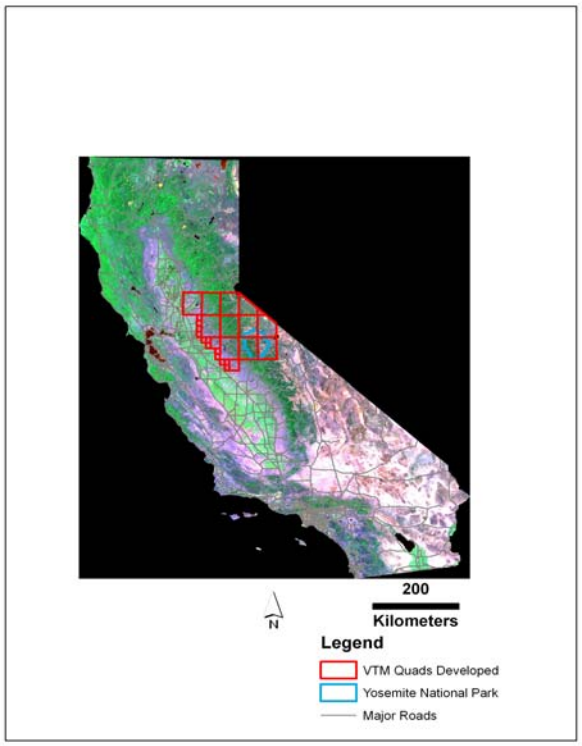

Figure 2. This project digitized Wieslander maps that include Yosemite National Park and portions of the Central Valley.

- **Reducing the environmental impacts of electricity generation.** Power generation is a major source of greenhouse gas emissions; consequently, the California Energy Commission is sponsoring climate change impact analyses. Such analyses will provide policy makers with solid science to inform their responses to global climate change. The digitized, GIS-compatible vegetation data developed in this project will enable researchers studying climate change to calibrate their dynamic vegetation models to conditions that existed in the 1930s and compare model predictions for the current time with today's actual conditions. In this way, models of ecosystem response to climate change can be validated and refined for greater accuracy, enabling a better-informed response to global climate change. Results from this project have already been shared with two other PIER-funded groups, the Berkeley Museum of Vertebrate Zoology and the BIOMOVE plant distribution modeling group.

[3] Schwind, B., and H. Gordon. 2001. *CalVeg Geobook: a Comprehensive Information Package Describing California's Wildland Vegetation,* version 2. USDA Forest Service, Pacific Southwest Region, Remote Sensing Lab, Sacramento, CA.

[4] The 1850 map was published by Weeks, D., A. E. Wieslander, and C. L. Hill. 1934. *The Utilization of Eldorado County Land.* Giannini Foundation, University of California Bulletin 572, Berkeley, CA.

Results

At low elevations, blue oak (*Quercus douglasii*) and foothill pine (*Pinus sabiniana*) areas were largely converted to grasslands: the extent of Blue Oak–Foothill Pine Woodlands decreased from 1,209.1 km^2 to 559.3 km^2.

At about 1000 meters elevation, the lower edge of the "Yellow Pine Belt" (dominated by *Pinus ponderosa*) has retreated upslope about 180 meters between 1934 and 1996, and by 526 meters since 1850. Ponderosa Pine Forests decreased from a historical extent of 3,444.5 km^2 to 1,238.7 km^2. At the upper elevation of its range, the Ponderosa Pine Forest was replaced mostly by Douglas Fir Forest or Sierran Mixed Conifer Forest. At the lower edge of its range, Ponderosa Pine Forest was replaced mostly by Montane Hardwood Forest and Annual Grasslands.

The WHR types that gained the most in extent were Sierra Mixed Conifer, which went from 1244 km^2 to 2951 km^2, and Montane Hardwoods, which grew from 1,123 km^2 to 2231 km^2.

Grazing, competition by nonnative grasses, and fire occurred on only 42% of the total area of change, and thus cannot account for the majority of vegetation shift. The authors hypothesize failure of conifer seedling establishment due to the earlier Sierra snowmelts that have been occurring with warmer temperatures. The lower edge of the Sierran conifer belt appears to be sensitive to climate change, a conclusion with implications for the water-holding capacity of the mountains.

Final Report

The final report for this project is posted on the Energy Commission's website at www.energy.ca.gov/pier/final_project_reports/CEC-500-2006-107.html.

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